3.0 Background

3.1 Location and Climate

The Midway Landfill is in King County, Washington, Between Interstate-5 (I-5) and Highway 99, and between South 252nd Street and South 246th Street in Kent, Washington 98032. Figure 1 shows the regional site location.

The location is in a geographic area known as the Puget Sound Lowland. The area has been glaciated several times and is underlain by a sequence of glacio-fluvial sediments. The area has a maritime climate characterized by cool, wet winters and drier, mild summers. Annual rainfall is about 40 inches per year, which falls mainly between November and June.

3.2 History and Regulatory Synopsis

The City of Seattle (City) operated the Midway Landfill from 1966 to 1983. When the City closed the Midway Landfill in 1983, extensive testing for landfill gas and analysis of groundwater in and around the landfill began. The presence of contaminants with a potential for off-site migration was indicated and the Washington State Department of Ecology (Ecology) began to investigate the site.

In 1986, the site was placed on the National Priorities List (NPL) by the Environmental Protection Agency (EPA) for groundwater conditions at the site. As required by the EPA, the City completed a remedial investigation (RI), an Endangerment Assessment (EA), and a Feasibility Study (FS).

In May 1990, prior to completion of the RI and FS studies, the City and Ecology entered into a consent decree pursuant to the State of Washington Model Toxics Control Act [MTCA], (Washington State Department of Ecology, 1996). This legal agreement set forth Ecology's determination that undertaking certain remedial actions, prior to a Cleanup Action Plan (CAP), would provide immediate protection to human health and the environment. The remedial actions were completed by 1992.

Under MTCA, the decision document that selects the cleanup action and cleanup levels is called the CAP (similar to an EPA Record of Decision [ROD]).

Ecology and the City had been working on a CAP since 1992. In September 2000, the EPA completed a Comprehensive Environmental Response Compensation Liability Act (CERCLA) ROD for the landfill so that a determination of CERCLA construction completion could be made (USEPA 2000). Ecology then decided to utilize the ROD as a CAP for a final MTCA remedy, pursuant to WAC 173-340-360(13).

3.3 Physical and Geographical Characteristics

The Midway Landfill is located near the crest of a narrow north-south trending glacier feature known as the Des Moines Drift Plain. This area, referred to as "upland" because of its location above adjacent valleys and sea level, is bordered by Puget Sound on the west and the Green River valley on the east. Maximum elevations along the crest of the upland generally range from 400 to 450 feet above mean sea level. Puget Sound is at sea level, and the Green River valley floor typically averages about 30 feet above mean sea level.

The Midway Landfill occupies a shallow, bowl-shaped depression near the crest of the upland. The surface of the landfill generally ranges from 360 to 400 feet above mean sea level and slopes upward to the south and east. West of the landfill, the land surface is nearly flat across Highway 99 and then drops steeply downward approximately 100 feet to the Parkside Wetland.

The upland area is cut with a number of steep-sided stream valleys. Midway Creek is located northeast of the landfill, and two other streams, the north and south forks of McSorley Creek, are located to the west and southwest, respectively.

There is no major surface water body in the immediate vicinity of the Midway Landfill. The closest are Lake Fenwick, located approximately one mile to the southeast, and Star Lake, located approximately 1.5 miles to the south.

3.4 Land and Resource Use

3.4.1 Land Use

Currently the landfill is capped and fenced. No public access is allowed. Future land use has been the subject of an extensive but preliminary 1992 study by community representatives, the City of Kent, and the City of Seattle. Some possible uses considered desirable by the Midway Citizens Advisory Committee include open space uses such as a passive park, a sports complex with ball fields, or garden center. Less desirable but potentially possible future uses would be a golf driving range or a park and ride facility. All uses would be designed to protect the integrity of the cap and other containment systems.

Occasionally there are inquiries from buyers of properties adjacent to or near the Midway Landfill. The inquiries request information on any environmental impacts to the property that the buyer may be interested in purchasing. Whenever such inquiries are received, the City of Seattle reviews the current environmental data with respect to the location of the property of interest. An example information letter from the City of Seattle to prospective purchasers of adjacent or nearby properties is provided in Appendix A.

3.4.2 Ground-Water Use

To the best of Ecology's and the City's knowledge, no one is drinking the groundwater from any aquifer within almost a mile of the landfill, and there are no current plans to use the groundwater near the landfill for drinking water. The closest wells currently in use for drinking water are the Lake Fenwick wells almost 1 mile southeast of the Midway Landfill.

There are three public wells in the Midway Landfill area. Two are operated by the Highline Water District near the two intersections of South 209th Street and 31st Avenue South, and South 208th Street and 12th Avenue South, respectively. These two wells are screened in the second confined aquifer, at over 120 feet below sea level. Both are over two miles north and northwest from the landfill in an area that is up gradient of the landfill, and are completed in aquifers that are not connected to the affected aquifers.

The third well is operated by the Kent Water District at South 212th Street and Valley Freeway and is used to satisfy peak summer demands. None of these municipal wells draw water from affected aquifers, and all are more distant from the landfill than are the Lake Fenwick wells.

Neither water district has future plans to develop groundwater supplies from any aquifers within an one-mile radius of the Midway Landfill. The wellhead protection areas delineated by these utilities do not include the Midway Landfill site.

State regulations (WAC 173-160 -171) do not allow any new private drinking water wells within 1000 feet of a solid waste landfill or 100 feet of all other sources or potential sources of contamination, and notice is required to be given to Ecology prior to the construction of any well. However, the NCP is more stringent and requires EPA to consider all groundwater as drinking water except directly under a waste management area. The landfill area with refuse is a waste management area and thus is not considered a future drinking water source by EPA. All other areas downgradient of the landfill are considered to be potential future drinking water sources. However, it is likely that all future developments lie within water district service areas and, therefore, are not likely to rely on private wells for their potable water supply.

3.5 History of Contamination

From 1945 to 1966, the site of the current Midway Landfill was operated as a gravel pit. Originally, the pit was adjacent to a natural drainage basin often used as a settling pond. This basin, known as Lake Meade, was located northeast from the center of the present landfill. As the pit was mined, water was drawn from Lake Meade to wash silt and clay from the gravel and sand, and then returned to the lake. This silt and clay settled on the lake bottom. Near the end of the gravel pit operation, the lake was drained into the southern end of the gravel pit, depositing a layer of clay and silt into the bottom of the pit. This layer of fine materials currently underlies much, but not all, of the present landfill.

In 1966, the City of Seattle leased the site and began using it as a landfill. From 1966 to 1983, approximately three million cubic yards of solid waste

were deposited there. The exact dimensions of the bottom of the landfill are not known. However, existing boreholes indicate that the solid waste extends as deep as 130 feet in some places.

The Midway Landfill was created primarily to accept demolition materials, wood waste and other slowly decomposing materials. However, some hazardous wastes and industrial wastes, including approximately two million gallons of bulk industrial liquids from a single source, were also placed in the landfill. In 1980, a state-mandated screening process administered by the Seattle-King County Department of Public Health was initiated to eliminate the disposal of any hazardous waste into Midway Landfill.

When the City closed the landfill in the fall of 1983, it began extensive testing of water and gas in the landfill and its vicinity. Samples of groundwater from monitoring wells in and around the landfill, and gas samples from gas probes, indicated the presence of organic and inorganic contaminants outside the landfill boundary. In 1985, Ecology also began investigating the site and found methane gas in nearby residences. Beginning in September 1985, the City of Seattle constructed gas migration control wells within the landfill property and gas extraction wells beyond the landfill property to control the subsurface migration of gas. Gas was found to have migrated up to 2600 feet beyond the landfill prior to installation of the gas extraction system.

3.6 Synopsis of Hydrogeology Setting

The ground water conditions beneath the landfill are very complex. A brief synopsis is provided to describe the important hydrogeologic features of the landfill.

Groundwater movement within and below the landfill has been characterized to an approximate depth of 300 to 350 ft below ground surface (50 to 100 ft above mean sea level. Several aquifers have been identified within this interval, including (from shallowest to deepest)

- Perched Aquifer (also referred to as Shallow Groundwater)
- Landfill Aquifer (also referred to as Saturated Refuse)

- Upper Gravel Aquifer (UGA)
- Sand Aquifer (SA)
- Southern Gravel Aquifer (SGA)
- Northern Gravel Aquifer (NGA)

The line of the generalized cross section of the monitored units is shown in Figure 2, and the cross section itself is shown in Figure 3.

The Perched Aquifer was named during the RI when it was believed to represent shallow, discontinuous lenses of groundwater perched on low permeability deposits above the UGA. Field work and data analysis since completion of the RI indicate that while this groundwater is shallow and discontinuous, it is not always perched. The majority of these shallow zones are found north of the landfill. The Perched Aquifer is referred to as Shallow Groundwater in the remainder of this report.

The Saturated Refuse consists of leachate within the landfill. Its occurrence and movement are largely functions of the former gravel pit topography. Flow in the Saturated Refuse is generally from the north and west toward the south central section of the landfill, where the pit excavations were deepest. Leachate likely discharges vertically throughout much of the landfill base, but the greatest volume of vertical flow is in the south central area. Leachate discharging from the landfill enters the underlying UGA.

A generalized potentiometric surface map of the UGA for March 2005 is presented as Figure 4. The UGA occurs immediately below the base of the landfill, is limited in lateral extent and is composed of silty and sandy gravel. The aquifer is typically semi-confined, although some parts are unconfined. Groundwater flow in the UGA is generally from both the north and south inward toward an area beneath the southern end of the landfill where the groundwater appears to discharge downward into the underlying SA.

The UGA and SA are separated by the Upper Silt Aquitard, a discontinuous layer of fine-grained silt, clayey silt, and silty fine sand. Vertical flow from the UGA into the SA is most pronounced in places where the aquitard is absent.

A generalized potentiometric surface map of the SA for March 2005 is presented as Figure 5. The SA occurs as a widespread deposit of interbedded sands and silts. Flow in this aquifer in the vicinity of the landfill is generally from the north and west to the southeast toward an apparent hydraulic sink. The sink occurs across a broad area beneath the southern part of the landfill and extends several hundred feet to the east. Groundwater south of this sink also flows towards the sink. Groundwater entering this sink appears to flow downward into the SGA. Some vertical flow outside the sink area also occurs from the SA downward into the SGA and NGA.

The SA and SGA are separated by the Lower Silt Aquitard. Like the Upper Silt Aquitard, the Lower Silt Aquitard is discontinuous and likely controls downward flow from the SA into the SGA.

The deepest stratigraphic units studied are the NGA and SGA; they occur at about the same elevation, but hydraulic heads in the NGA are typically 100 ft higher than heads in the SGA. A generalized potentiometric surface map of the SGA for March 2005 is presented in Figure 6.

The SGA is found beneath the southern half of the landfill and extends to the east, south, and west. It consists of permeable sands and gravel interbedded with silts and silty gravel. The SGA appears to be recharged by the SA and by lateral flow from the south. A groundwater mound in the SGA, below the hydraulic sink in the SA, is believed to be an expression of flow through the sink. Groundwater flow from the mound is to the east and west; flow to the north is blocked by higher potentiometric heads within the NGA. Groundwater in the SGA eventually discharges west to Puget Sound and east to the Green River Valley.

The NGA is found beneath the northern half of the landfill and extends to the north and northeast. Like the SGA, the NGA consists of permeable sands and gravel interbedded with silts and silty gravel. Flow from the NGA is generally from north to south toward the SGA. Like the SGA, the NGA eventually discharges to Puget Sound and the Green River Valley.

Flow rates within the aquifers and along critical flow paths are very difficult to estimate at Midway Landfill because of the complex stratigraphy and the

strong vertical gradients. Based on evidence from calculated hydraulic conductivities, estimated porosities, and measured hydraulic heads, flow rates in the aquifers beneath Midway Landfill range from less than 0.01 to 10 ft per day. Given that flow rates of 0.1 to 1 foot per day are most likely, actions affecting leachate discharge or quality would be detectable in the groundwater monitoring network between 3 months and 30 years after they occurred. Note that the groundwater monitoring wells were selected in representative upgradient and downgradient sampling locations based on flow directions within each aquifer. Monitoring has been conducted at the site for over 15 years. Over this period, flow rates have been sufficient to allow observation of substantial changes in fluid level and chemical monitoring data in response to remedial actions.

4.0 Pre-ROD Remedial Actions

4.1 Remedy Selection and Implementation

In May 1990, prior to completion of the remedial investigation and feasibility studies, the City and Ecology entered into a consent decree pursuant to State of Washington Model Toxics Control Act (MTCA.) This legal agreement set forth Ecology's determination that undertaking certain remedial actions at Midway Landfill, prior to a Cleanup Action Plan (a MTCA decision document, similar to a Superfund ROD) would provide immediate protection to public health and the environment. In this consent decree, the City of Seattle agreed to finance and perform specific cleanup work. This cleanup work, or remedial action, consisted of the elements described in the following sections.

4.2 System Operations/Operation and Maintenance (O&M)

4.2.1 Gas Control

An active gas control system was installed at the Midway Landfill. It originally included 87 gas extraction wells, 31 of which were located off the landfill in native soil. The off-landfill wells have since been abandoned or capped. In addition, approximately 70 off-landfill gas monitoring probes were installed to provide information on gas concentrations; about half of these probes have since been abandoned. The gas is extracted through the control

wells at the landfill and routed to a permanent blower/flare system. Construction of the gas migration control system began in September 1985 and was completed in March 1991.

4.2.2 Landfill Surface Filling and Grading

The landfill surface was regraded which increased the soil cover over the landfill by 2 to 14 feet. The engineered grades improved surface water runoff and decreased infiltration. The fill was also compacted to reduce permeability and prepare the surface for the cover system. The work began in August 1988 and was competed in June 1989.

4.2.3 Storm Water Detention Pond

The storm water detention pond includes the landfill dewatering and discharge system. A lined detention pond was constructed to the north of the landfill. Re-grading of the landfill surface redirected surface water to the new detention pond. Previously, the surface water infiltrated into the landfill. The detention pond is a 3 acre structure, lined with a 60-millimeter high-density polyethylene membrane (HDPE) to eliminate infiltration. The bottom of the pond was constructed below localized groundwater; therefore, a permanent dewatering system was also installed. Construction of the storm water detention pond began in August 1988 and was completed in June 1989.

4.2.4 Landfill Cap Installation

Construction of the final landfill cover began in October 1989 and was completed in May 1991. It consists of the following layers from bottom to top: a 12-inch thick layer of low permeability (1 x 10-7 cm/sec) soil/clay material; a 50 millimeter HDPE flexible membrane; drainage net; filter fabric; 12-inch-thick drainage layer; and a 12-inch-thick topsoil layer.

4.2.5 Linda Heights Park Storm Water Diversion

The Linda Heights Park drain, a 30-inch culvert that drained directly into the landfill, was blocked. Storm water is now routed through a pump station and a pipeline to the detention pond. The old discharge line to the landfill is still in place and functions as an overflow in the event of a pump station failure. The construction of this rerouting began in August 1989 and was completed in

1991. The pump station and associated diversion of storm water was activated in January 1992.

4.2.6 Operations and Maintenance (O&M) Plan

A comprehensive operation and maintenance manual for both short-term and long-term operation and maintenance for the systems constructed under the consent decree was prepared by the City of Seattle, and was approved by Ecology in April 1992.

The 1990 consent decree also required the City to place a notice in the records of real property kept by the county auditor stating that the landfill was on the NPL, and serve a copy of the consent decree upon any prospective purchaser, lessee, transferee, assignee, or other successor in interest to the property prior to the transfer of any legal or equitable interest in all or any portion of the landfill.

4.3 Record of Decision Remedy

A final remedy for Midway Landfill was selected by EPA with Ecology's concurrence in September 2000. The selected remedy consisted of:

1. Monitoring to :

   (a) Determine if the remedial systems are working as designed,

   (b) Determine the progress towards meeting the groundwater cleanup standards,

   (c) Determine if adequate containment is maintained when and if major changes are approved by the Department of Ecology in the operation of the site, such as turning off or scaling down the gas collection system, and

   (d) Demonstrate that the cleanup levels have been achieved.

   The monitoring will be done by the City of Seattle, while Ecology will continue to be the lead cleanup regulatory agency at the site. The details of the monitoring requirements have been set out by the City of Seattle in an Ecology-approved compliance monitoring plan.

Monitoring, including installation of new monitoring wells, is among the activities EPA expects at sites even after EPA determines that construction has been "completed" at a site. Through the procedures outlined in the agreements between Ecology and the City of Seattle, Ecology may require the City of Seattle to install and monitor new monitoring wells if needed.

If necessary, the monitoring program may also address the issue of the source of turbidity in North McSorley Creek raised by the City of Des Moines in their comment letter on the proposed plan. The City of Des Moines requested that the City of Seattle continue to monitor the S. 250th Street outfall for turbidity during storm events (on a periodic basis) and provide the results to the City of Des Moines Engineering Department.

2. Continuing to operate and maintain all remedial elements required in the 1990 consent decree. Ecology will continue to oversee the City's operation and maintenance activities. Operational changes can be approved by Ecology when such changes ensure that the site and remedy will remain protective. The Seattle King County Public Health Department should be given the opportunity to review requested operational changes.

3. Implementing institutional controls. Institutional controls are legal or administrative actions that help ensure the long-term protectiveness of the remedy. At this site, the selected remedy consists of three types of institutional controls. Variations of the first two types of institutional controls are already required in the 1990 consent decree.

   (a) First, the City of Seattle will place a notice in the records of real property kept by the King County auditor, alerting any future purchaser of the landfill property, in perpetuity, that this property had been used as a landfill and was on EPA's National Priorities List, and that future use of the property is restricted. The use restriction shall comply with the post-closure use restrictions under the State of Washington's Criteria for Municipal Solid Waste Landfills (WAC 173-351-500(1)(I) and (2)(c)(iii). The City has recorded this note with King County on July 13, 2005.

(b) Second, the City needs to ensure continued operation and maintenance of the containment and monitoring systems if any portion of the property is sold, leased, transferred or otherwise conveyed. This requirement is an element of the 1990 consent decree.

(c) Third, notices are needed so that no water supply wells are constructed and used in areas with groundwater contamination emanating from the landfill. These notices shall include at a minimum the following:

- The City will annually notify the Seattle-King County Department of Public Health, Ecology, the local water districts (currently, the Kent and Highline Water Districts) and locally active well drillers in writing of groundwater conditions in the affected areas downgradient of the landfill. This notice will include a map showing the location of the affected areas and indicate which aquifers are affected and their elevations. This information shall be updated annually and can be part of an annual groundwater monitoring report. Locally active well drillers are all well drillers that have drilled wells within King County in the year prior to the notice. Ecology will provide the list of locally active well drillers to the City. This requirement for annual notices can be removed or modified by Ecology after groundwater cleanup standards have been met in the groundwater monitoring wells downgradient from the landfill. A copy of the 2005 notice to local drillers is provided in Appendix D.

- The City of Seattle will also annually notify owner of Well #37 in writing of groundwater conditions in the area of the well. Alternatively, the City of Seattle can provide to Ecology adequate assurances that this well has been properly abandoned.

As an additional protection, state regulations forbid any private drinking water wells within 1,000 feet of a municipal landfill or 100 feet from all other sources or potential sources of contamination (WAC 173-160-171). State regulations (WAC 173-160-151) also require a property owner, agent of that owner, or a water well operator to notify Ecology of their intent to begin well construction prior to beginning work. This notification can provide notice to Ecology if anyone plans to build a new water well too near Midway Landfill.

Ecology will continue to be the lead regulatory agency overseeing the performance of the selected remedial action by the City of Seattle. However, if necessary, EPA could use its statutory authority to ensure that actions selected by this ROD are implemented.

The groundwater cleanup standards for the current contaminants of concern can be found in Table 1. If other contaminants resulting from releases from the landfill are found in any down gradient monitoring well, cleanup levels, if necessary, will be established for these additional contaminants using the federal drinking water standards and MTCA.

The point of compliance for the groundwater will be at the edge of the landfill waste as specified in a Compliance Monitoring Plan approved by Ecology. Under MTCA, this location is considered a "conditional point of compliance." All groundwater downgradient of this point of compliance will need to meet these cleanup levels for contaminants resulting from releases from the landfill before the Midway Landfill is removed from the Superfund National Priorities List.

> One of the City of Seattle's concerns is that contaminated groundwater is coming into the landfill from up gradient sources, and that this in-coming contaminated groundwater will never allow the groundwater leaving the landfill to meet the groundwater cleanup standards. Because of the major improvements in downgradient water quality in the last ten years, EPA believes it is possible that the groundwater leaving the landfill will eventually meet the groundwater cleanup standards. However, if in the future the City wants to demonstrate that it is technically impracticable for them to meet the cleanup standards at every downgradient well because of the up gradient sources, EPA and Ecology will work together with the City to determine what information is needed to support such a demonstration.

Because the selected remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted under CERCLA within five years of this Record of Decision to ensure that the remedy continues to be protective of human health and the environment. Because Ecology is expected to continue

to be the lead regulatory agency for this cleanup, EPA would expect Ecology to perform the five year review at this site.

The City of Seattle estimates that the closure costs of Midway Landfill amounted to about $56.5 million as of 1995. This does not include the ancillary costs associated with the landfill such as the "Good Neighbor Policy". In recent years, the budgeted and actual operation and maintenance costs have ranged from $432,000 to $535,600 annually. This amount includes monitoring costs.

Groundwater Cleanup Standards

Table 1. List of Contaminants of Concern and Cleanup Standards

Contaminant	Cleanup Level	Basis of the Cleanup Level
Manganese	2.2 mg/L	MTCA Method B
1,2-dichloroethane	5 µg/L	Federal Drinking Water Standard (MCL)
vinyl chloride	.02 µg/L*	MTCA Method B.

NOTES:

(*) Pursuant to WAC 173-340-707(2), Ecology will utilize the practical quantification limit (PQL) of 0.2 µg/L to determine compliance with this cleanup standard because the cleanup standard is lower than the PQL.

(1) 1,2-Dichloroethane and vinyl chloride are solvents. Vinyl chloride can also be formed in groundwater during the natural breakdown of other solvents. Manganese is a natural mineral in soil that dissolves into the groundwater because of the chemistry of the water leaving the landfill.

(2) If other contaminants resulting from releases from the landfill are found in any downgradient monitoring well, cleanup levels, if necessary, will be established for these additional contaminants using the federal drinking water standards and MTCA.

(3) The point of compliance for the groundwater will be at the edge of the landfill waste as specified in a Compliance Monitoring Plan to be approved by Ecology. Under MTCA, this location is considered a "conditional point of compliance." All groundwater downgradient

of this point of compliance will need to meet these cleanup levels for contaminants resulting from releases from the landfill before the Midway Landfill is removed from the Superfund National Priorities List.